DOCUMENT RESUME

ED 379 401 CE 067 769

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TITLE Merging Quality Processes & Tools with DACUM.
PUB DATE Dec 94
NOTE 26p.; Paper presented at the DACUM Invitational (Dallas, TX, December 7-8, 1994).
PUB TYPE Speeches/Conference Papers (150) -- Reports - Descriptive (141)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Curriculum Development; Educational Principles; *Educational Quality; Foreign Countries; Guidelines; Integrated Curriculum; Job Analysis; *Job Training; *Total Quality Management; *Vocational Education
IDENTIFIERS *Canada; *DACUM Process

ABSTRACT

This paper explains how merging DACUM (Developing a Curriculum) analysis with quality initiatives can reduce waste, increase job efficiency, assist in development of standard operating procedures, and involve employees in positive job improvement methods. In the first half of the paper, the following principles of total quality management (TQM) are explained: use of statistical process control (SPC) tools, high efficiency, existence of standard operating procedures, and high employee involvement programs. The remainder of the paper outlines detailed procedures for using each of the following SPC tools with DACUM: brainstorming, flowcharting, Failure Modes and Effects Analysis (FMEA), and Pareto Analysis. Appended are the following: example of a DACUM job profile, FMEA criteria tables for operations and administrative functions, Pareto analysis data and graph, sample flowchart job aid, and sample standard operating procedure. (MN)

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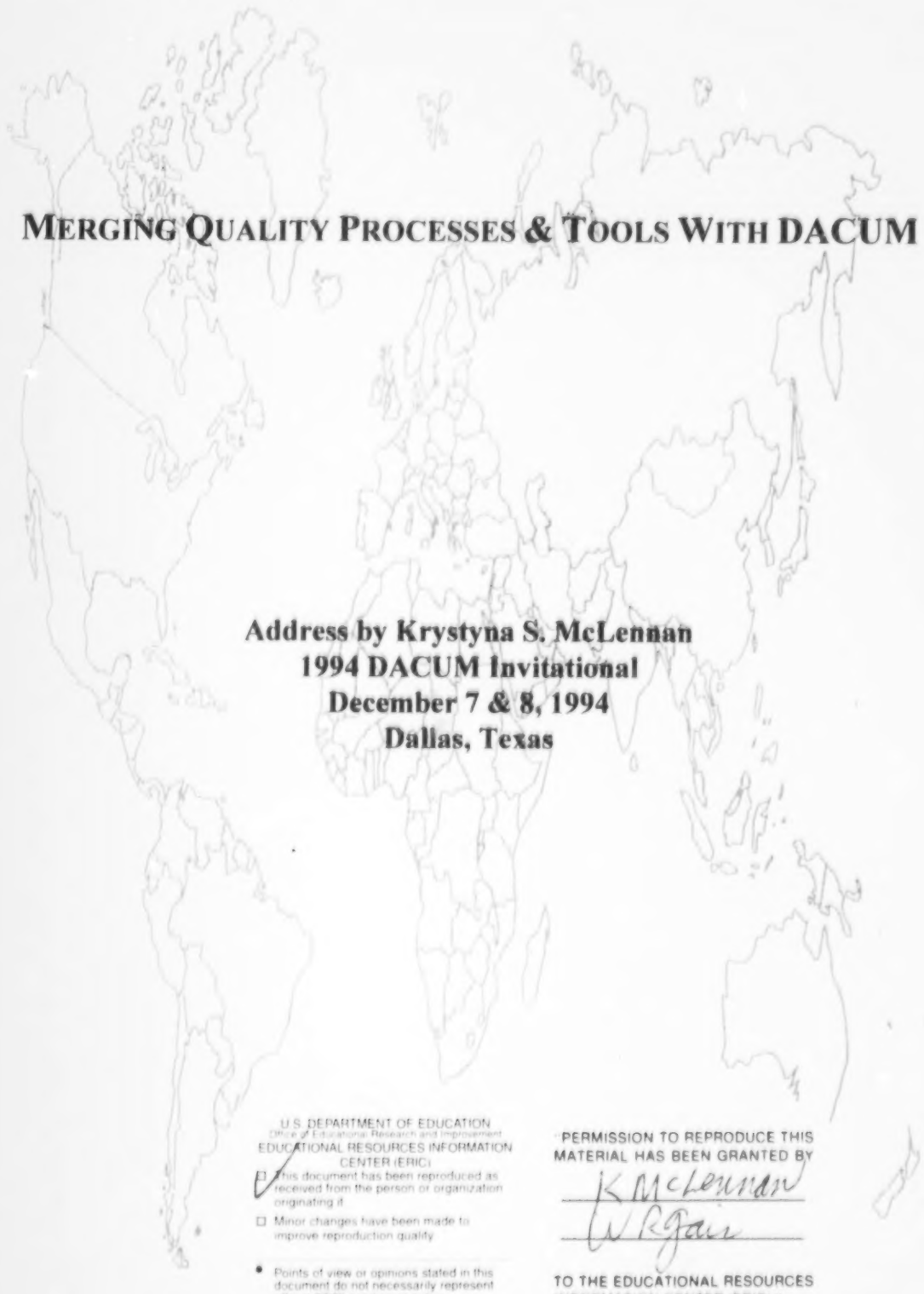
MERGING QUALITY PROCESSES & TOOLS WITH DACUM



Address by Krystyna S. McLennan
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Organizations are always struggling to find ways of bringing quality improvement methods into administrative areas such as Human Resources. This paper will explain, how the merging of DACUM analysis with quality initiatives will give us the means to reduce waste, increase job efficiency, assist in the development of standard operating procedures, and involve the employees in positive job improvement methods. The use of SPC tools provides an objective analysis for the subjective information gathered in the DACUM process.

The intent of this presentation is to demonstrate the integration of Total Quality philosophy and techniques with the job analysis and performance process.

Total Quality Management

If you have ever been involved with customer quality audits or the pursuit of the ISO 9000 series designations, you know that some of the critical factors that must be demonstrated within your organization are:

1. **Use of Statistical Process Control Tools**
2. **High Efficiency**
3. **Existence of Standard Operating Procedures**
4. **High Employee Involvement Programs.**

Dofasco Inc., a fully integrated Canadian Steel Mill and a recent recipient of the Ford Q1 Award has been very successful in implementing a full quality program through out the organization. One approach we have used in addressing these four areas is the merging of quality processes and tools with DACUM job analysis.

Quality Improvement programs rely on SPC tools to monitor the consistency and quality of our processes along with the impact of any changes that have been introduced. They help us analyze where we are presently and then monitor our progress in getting to where we want to be.

Efficiency is also very important to external customers. Efficiency is defined as the ratio of outputs to inputs. This means using one piece of paper to wrap a present instead of six. Customers want to see high efficiency in an organization because this indicates that they are not paying for waste. Time and energy spent inefficiently results in higher costs to the organization. These costs are ultimately buried in the price of the product and absorbed by the customer.

Employee involvement is essential in implementing Total Quality. Employees have the experience and are the most knowledgable in regards to doing the job. Harnessing those elements results in excellent input, greater 'buy-in' and motivated employees.

Defining standard operating procedures for key tasks within each job is a difficult undertaking, but a must when implementing a Quality Program. Standard operating procedures, when followed, ensure consistent practices and provide excellent guidelines for troubleshooting.

The DACUM process has helped us in addressing these four issues with its systematic approach to job analysis. A give and take symbiotic relationship has evolved between DACUM and our Quality Programs.

Use of SPC Tools With DACUM

We are using the following four SPC tools to analyze the DACUM job profiles (Refer to Attachment 1 - Example of DACUM Profile).

1. **Brainstorming**
2. **Flow Charting**
3. **Failure Modes and Effects Analysis (FMEA)**
4. **Pareto Analysis**

Brainstorming is a SPC tool used to generate possible causes and/or solutions to a problem. It is the process of thinking out loud by a group of people who are knowledgeable, experienced, or possess expertise in a specific area. The DACUM process utilizes this tool effectively during the development of the job profiles.

Flow-charting is used to analyze tasks by breaking down the steps and components required to perform a task. The flow chart is easy to follow and makes an excellent job aid.

Once the DACUM job profile has been developed, we ask our panel to rate each task according to frequency, criticality, and learning difficulty. This process is an adaptation of a SPC tool known as ***Failure Modes and Effects Analysis (FMEA)*** where product characteristics, process variables, or equipment is rated. Through an FMEA each characteristic is rated on:

1. ***Occurrence*** **- How frequently does it fail or what's the probability of failure.**
2. ***Severity*** **- How important is this feature to the customer.**
3. ***Detection*** **- How good is our detection system in allowing us to detect failure.**

The three numbers are multiplied together produce a ***Risk Priority Number (RPN).*** The RPN indicates how large of a contribution each characteristic has on the failure.

With minor modifications we use this tool in rating each task on the DACUM job profile in the same manor (See Attachment 2 - Criteria Tables). Using a scale of 1 to 6 the tasks are rated on:

1. ***Frequency*** **- How often is this task preformed.**
2. ***Criticality*** **- If the task was performed incorrectly, what would the impact be on the operations.**
3. ***Learning Difficulty*** **- How difficult is it to learn this task.**

We then multiply frequency, by critically, by learning difficulty and come up with the ***Task Priority Number (TPN).***

Another SPC tool known as ***Pareto Analysis*** allows you prioritize the tasks from most to least critical. We use a variation of this tool by graphing the TPN numbers from high to low (See Attachment 3 - Pareto Analysis Data Sheet). The graph is analyzed by dividing it into three groups: the first third is considered the high priority tasks, the second third consists of moderate priority tasks, and the last third are the low priority tasks. This technique allows you to work on the DACUM chart one section at a time instead of the entire chart all at once.

High Efficiency

Once the tasks are rated and the Pareto Analysis completed, we can begin to work on the critical top third; but the other two thirds certainly cannot be ignored. The tasks with moderate priority TPN numbers are the next group to be investigated and the tasks with low TPN numbers are considered to be low priority and left till the end.

This prioritization allows you to better understand the job. For example, upon investigation of the low priority tasks, we have found numerous occasions when the tasks were not required but employees were still preforming them. During some part of the job this task was necessary but due to automation or technological improvements, the task has become obsolete; unfortunately this was not communicated to the employee. These tasks have been identified and removed from the job. On other occasions we have discovered that two different job functions were performing the same task, and now we have a duplication of effort. These tasks were isolated and a determination was made as to which job function would take the responsibility for them therefore eliminating duplication.

These are just a few examples of how the DACUM process complements the quality initiatives of efficiency and reduction of waste.

Development of Standard Operating Procedures

The rated tasks play a key role in the development of Standard Operating Procedures. Each task with a high to moderate TPN number is designated for task analysis. The task analysis is performed by flow-charting the task's steps out in detail (See Attachment 4 - Example of Task

Flow Chart). These flow-charts become significant in the development of the standard operating procedures because they highlight areas where a standard operating procedure is required (See Attachment 5 - Example of Standard Operating Procedure).

High Employee Involvement

The DACUM process demands high employee involvement - during the two day workshop its the employees doing the job that are selected to define the job. Additional employee involvement is generated in the validation stage where all employees familiar and experienced with that job are asked to review the job profile and provide their input. These employees know that the profiles were developed by their peers, not supervision, and this generates greater buy-in.

Summary

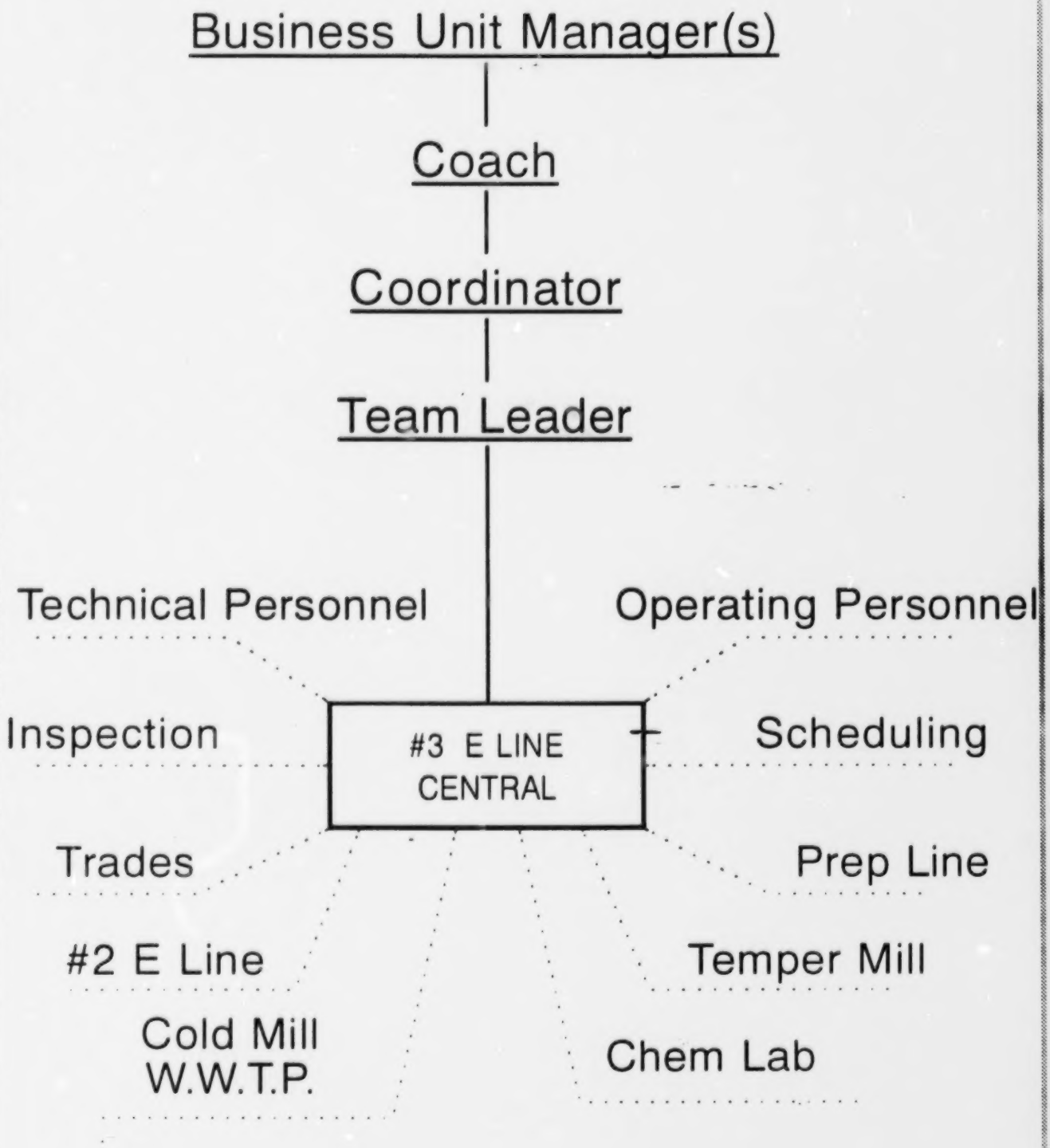
The application of quality concepts and tools is being applied to all aspects of running an organization. Quality tools are being applied in fields of applied behavioral analysis, performance management, organizational development, and performance technology. The DACUM process has been very instrumental in linking quality concepts with these areas. We have seen benefits through:

1. A more efficient DACUM process resulting in prioritized tasks and,
2. An immediate reduction in wasted time by automating or eliminating redundant and outdated tasks that our employees were performing.

We have had much success with this combination within our Quality organization and we hope it will benefit yours.

Attachment 1

Example of a DACUM Job Profile



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TIN MILL - #3 E LINE CENTRAL

BEHAVIOURS, TRAITS & ATTITUDES

- Open minded
- Reliable
- Experimental
- Dedicated
- Safety conscious
- Honest
- Analytical
- Responsible
- Friendly
- Decisive
- Pro-active
- Inquisitive
- Leadership
- Logical
- Helpful
- Team player

TOOLS & EQUIPMENT

- Mechanical tools
- Floodlight
- Chemicals
- Personal safety equipment
- Monogoggles
- Team locker tools
- Flashlight
- Leather-faced gloves
- Polishing sticks

FUTURE TRENDS

- On-line computer systems
- Toyokohan recommendations
- Tension leveller
- Equipment improvements
- Containment systems
- Benchmarking
- Equipment Upgrading
- Increased automation

GENERAL SKILLS & KNOWLEDGE

- Communication skills
- Reading & writing skills
- SPC training
- Maintenance skills training
- Process knowledge
- Mechanical skills
- WHMIS training

DACUM OF DOFASCO TIN MILL E LINE CENTRAL - #3 E LINE

February 10,11,1994

DUTIES — TASKS

	DUTIES	TASKS										
A	PREPARE LINE TO RUN TIN PLATE PRODUCT	A1 Setup line according to specifications 6 5 4 = 120	A2 Set coating weight control to coating specs 6 5 5 = 150	A3 Setup width indicator 8 5 3 = 90	A4 Setup re-flow sprays 6 5 5 = 150	A5 Change chemical treat bath to CDC or SDD 6 5 3 = 90	A6 Set oiler to specifications 5 5 3 = 75	A7 Assist with setup of line marker 3 4 4 = 48	A8 Set pickle amps to specifications 3 3 3 = 27	A9 Set cleaner amps to specifications 3 3 3 = 27	A10 Test line prior to start up 6 5 5 = 150	
B	PREPARE LINE TO RUN CHROME STEEL PRODUCT	B1 Set coating weight control for chrome steel 8 5 4 = 120	B2 Adjust temperature of chrome steel tank 6 5 4 = 120	B3 Verify volume of chrome steel tank 8 5 4 = 120	B4 Maintain concentration of chrome steel tank 6 5 4 = 120	B5 Verify volume of chrome steel rinse sprays 6 5 5 = 150	B6 Adjust pressure of chrome steel rinse sprays 6 5 5 = 150	B7 Adjust temperature of chrome steel rinse sprays 8 4 3 = 72	B8 Test line prior to start up 6 5 5 = 150			
C	MONITOR CHEMICAL SOLUTIONS	C1 Maintain temperature of tin electrolyte tank 6 5 5 = 150	C2 Maintain volume of tin electrolyte tank 6 4 4 = 96	C3 Maintain concentration of tin electrolyte tank 8 5 4 = 120	C4 Maintain volume of drag outs 6 5 4 = 120	C5 Maintain concentration of drag outs 6 5 4 = 120	C6 Maintain temperature of quench tank 6 5 4 = 120	C7 Maintain temperature of quench sprays 6 5 4 = 120	C8 Maintain volume of CDC tank 6 5 3 = 90	C9 Maintain temperature of CDC tank 6 4 3 = 72	C10 Maintain pressure of CDC spray 6 5 3 = 90	C11 Maintain temperature of CDC spray 8 4 3 = 72	C12 Maintain volume of cleaner solution 6 4 3 = 72
		C13 Maintain temperature of cleaner section 6 4 3 = 72	C14 Maintain volume of cleaner dip tank 6 2 2 = 24	C15 Maintain temperature of cleaner dip tank 8 2 2 = 24	C16 Maintain volume of pickle tank 6 5 3 = 90	C17 Maintain pressure of pickle rinse spray 6 5 3 = 90	C18 Maintain pressure of cleaner rinse sprays 8 4 3 = 72					
D	TROUBLESHOOT LINE PROBLEMS	D1 Identify product defects 6 5 5 = 150	D2 Determine origin of defects 6 5 5 = 150	D3 Eliminate defect sources 8 5 5 = 150	D4 Prepare defect reports 3 2 2 = 12	D5 Clean up chemical spills 2 5 5 = 50	D6 Assist trades people with line repairs 5 3 4 = 60	D7 Perform inspection rounds 8 4 3 = 72	D8 Change line over to city water 1 4 3 = 12			
E	RUN DIFFERENT PRODUCT LINES	E1 Change over from tin to chrome 3 5 5 = 75	E2 Change over from chrome to tin 3 5 5 = 75	E3 Change over from tin to black plate 2 4 3 = 24	E4 Change over from black plate to tin 2 4 3 = 24							
F	PERFORM GENERAL TEAM DUTIES	F1 Prepare communication reports 6 4 3 = 72	F2 Order supplies, tools and equipment 6 4 3 = 72	F3 Communicate operating status to line crew 5 4 3 = 60	F4 Shut down line for scheduled maintenance 3 5 5 = 75	F5 Start up line after scheduled maintenance 3 5 5 = 75	F6 Develop work/shift schedules 5 4 3 = 60	F7 Generate production reports 3 5 4 = 60	F8 Maintain maintenance log book 6 4 2 = 48	F9 Maintain hard copy file system 6 1 1 = 6	F10 Train new operators 5 5 5 = 125	F11 Clean up work area 5 2 2 = 20	F12 Assist with safety of the workplace inspections 3 5 3 = 45

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Paul Lampman, Peter Osinga

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DACUM SPONSORS:
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Mary Grandits

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Attachment 2

FMEA Criteria Tables for Operations and Administrative Functions

DACUM RATING CHART
For Operations

Rating	Frequency	Criticality	Difficulty to Learn
1	Once a Year	Little or no Impact	None
2	Once a Month	Small Impact	Easy
3	Once or Twice a Week	Moderate Impact	Basic
4	Once a Day	Noticeable Impact	Moderately Difficult
5	Once a Shift	Serious Impact	Hard
6	More Than Once a Shift	Catastrophic Impact Death or Destruction	Extremely Difficult

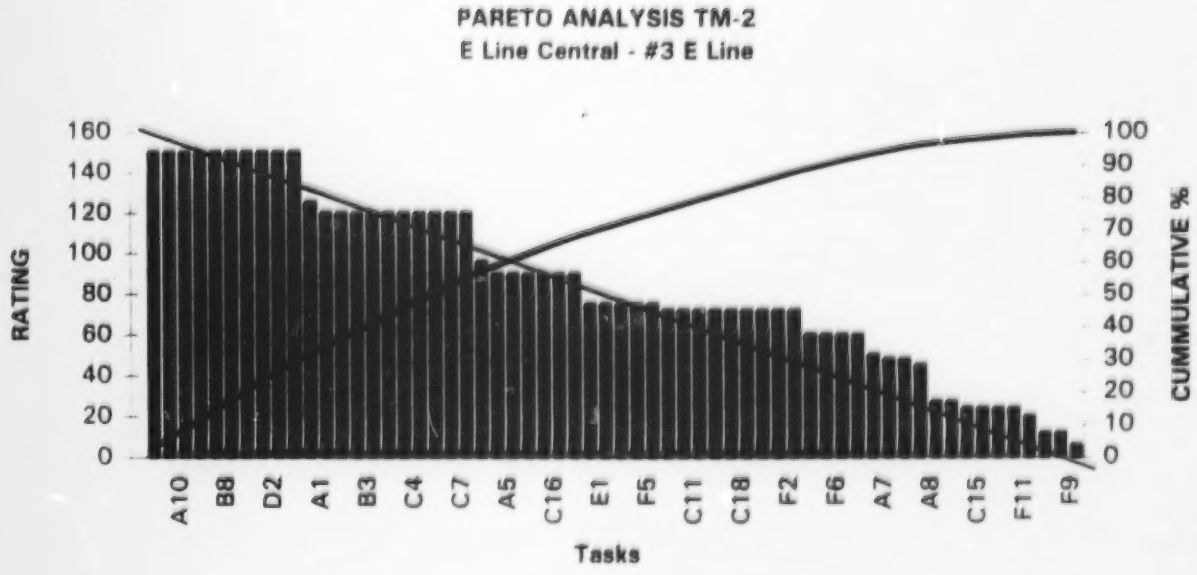
DACUM RATING CHART

For Administration

Rating	Frequency	Criticality	Difficulty to Learn
1	Once or Twice a Year	Little or No Impact	None (Innate Skills)
2	Once or Twice a Quarter	Small Impact	Easy (Simple Instruction)
3	Once or Twice a Month	Moderately Noticeable Impact	Basic (On the Job Training)
4	Once or Twice a Week	Highly Noticeable Impact	Moderate (Combination of on the Job & Formal Training)
5	Once or Twice a Day	Serious Impact	Hard (Requires Formal Training)
6	Several Times a Day	Catastrophic Impact (High Costs, Loss of Customers)	Extremely Difficult (Requires Certification or Extensive Training)

Attachment 3

Pareto Analysis Data and Graph

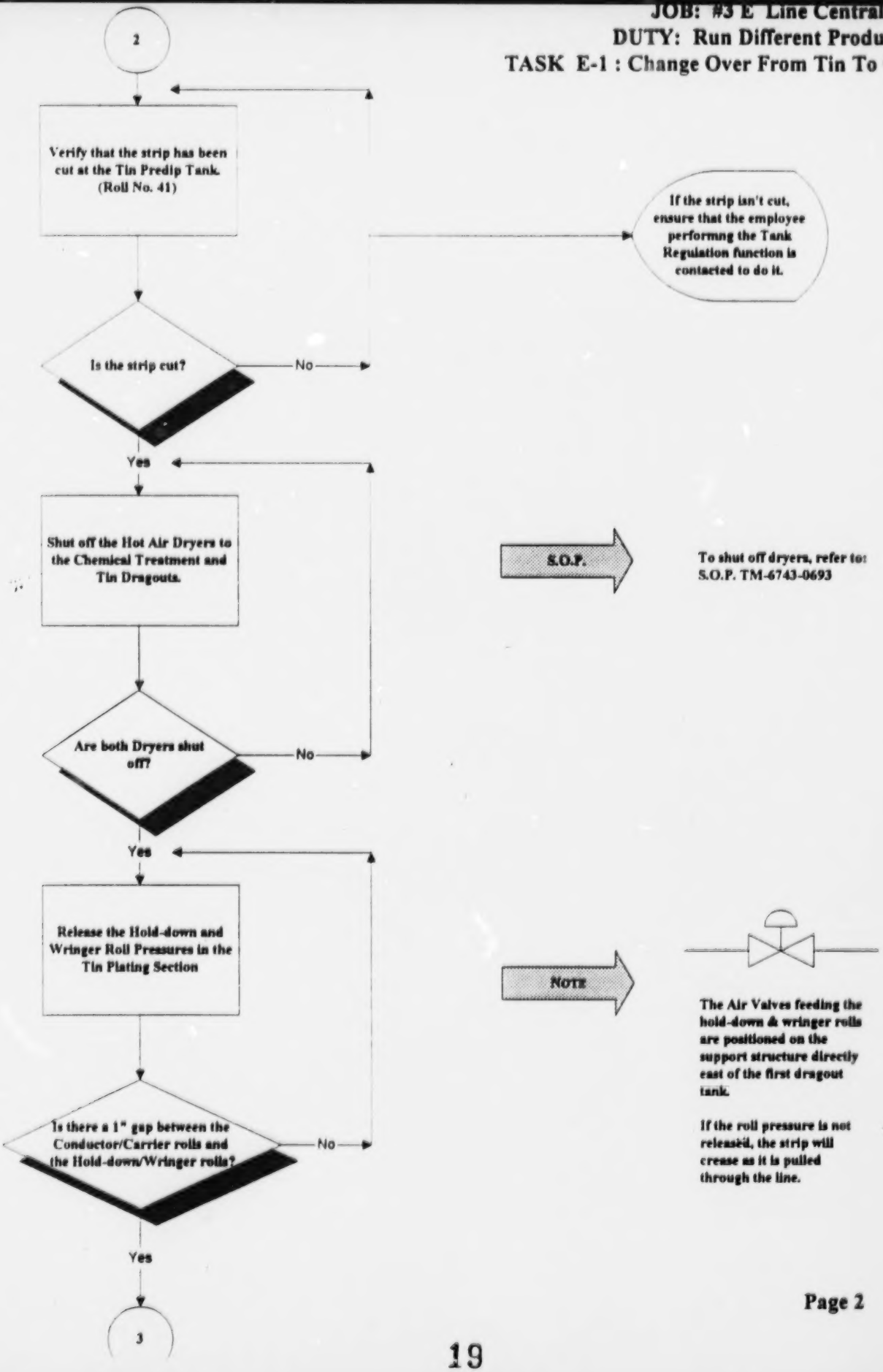

PARETO ANALYSIS TM-2
E Line Central - #3 E Line
RATING
160
140
120
100
80
60
40
20
0
100
90
80
70
60
50
40
30
20
10
0
CUMMULATIVE %
A10
B8
D2
A1
B3
C4
C7
A5
C16
E1
F5
C11
C18
F2
F6
A7
A8
C15
F11
F9
Tasks

Pareto Analysis TM-2

Task	*F*	*C*	*LD*	*Total*	*%*	*Cumm%*
A-2	6	5	5	150	2.93	2.93
A-4	6	5	5	150	2.93	5.86
A-10	6	5	5	150	2.93	8.79
B-5	6	5	5	150	2.93	11.72
B-6	6	5	5	150	2.93	14.65
B-8	6	5	5	150	2.93	17.58
C-1	6	5	5	150	2.93	20.51
D-1	6	5	5	150	2.93	23.44
D-2	6	5	5	150	2.93	26.37
D-3	6	5	5	150	2.93	29.30
F-10	5	5	5	125	2.44	31.74
A-1	6	5	4	120	2.35	34.09
B-1	6	5	4	120	2.35	36.44
B-2	6	5	4	120	2.35	38.79
B-3	6	5	4	120	2.35	41.14
B-4	6	5	4	120	2.35	43.49
C-3	6	5	4	120	2.35	45.84
C-4	6	5	4	120	2.35	48.19
C-5	6	5	4	120	2.35	50.54
C-6	6	5	4	120	2.35	52.89
C-7	6	5	4	120	2.35	55.24
C-2	6	4	4	96	1.88	57.12
A-3	6	5	3	90	1.76	58.88
A-5	6	5	3	90	1.76	60.64
C-8	6	5	3	90	1.76	62.4
C-10	6	5	3	90	1.76	64.16
C-16	6	5	3	90	1.76	65.92
C-17	6	5	3	90	1.76	67.68
A-6	5	5	3	75	1.47	69.15
E-1	3	5	5	75	1.47	70.62
E-2	3	5	5	75	1.47	72.09
F-4	3	5	5	75	1.47	73.56
F-5	3	5	5	75	1.47	75.03
B-7	6	4	3	72	1.41	76.64
C-9	6	4	3	72	1.41	77.85
C-11	6	4	3	72	1.41	79.26
C-12	6	4	3	72	1.41	80.67
C-13	6	4	3	72	1.41	82.08
C-18	6	4	3	72	1.41	83.49
D-7	6	4	3	72	1.41	84.9
F-1	6	4	3	72	1.41	86.31
F-2	6	4	3	72	1.41	87.72
D-6	5	3	4	60	1.17	88.89
F-3	5	4	3	60	1.17	90.06
F-6	5	4	3	60	1.17	91.23
F-7	3	5	4	60	1.17	92.4
D-5	2	5	5	50	0.98	93.38
A-7	3	4	4	48	0.94	94.32
F-8	6	4	2	48	0.94	95.26
F-12	3	5	3	45	0.88	96.14
A-8	3	3	3	27	0.53	96.67
A-9	3	3	3	27	0.53	97.2
C-14	6	2	2	24	0.47	97.67
C-15	6	2	2	24	0.47	98.14
E-3	2	4	3	24	0.47	98.61
E-4	2	4	3	24	0.47	99.08
F-11	5	2	2	20	0.39	99.47
D-4	3	2	2	12	0.23	99.7
D-8	1	4	3	12	0.23	99.93
F-9	6	1	1	6	0.12	100.0
Total				5,115		

Attachment 4

Example of a Flow Chart Job Aid


2
Verify that the strip has been cut at the Tin Predip Tank. (Roll No. 41)
If the strip isn't cut, ensure that the employee performng the Tank Regulation function is contacted to do it.
Is the strip cut?
No
Yes
Shut off the Hot Air Dryers to the Chemical Treatment and Tin Dragouts.
S.O.P.
To shut off dryers, refer to: S.O.P. TM-6743-0693
Are both Dryers shut off?
No
Yes
Release the Hold-down and Wringer Roll Pressures in the Tin Plating Section
NOTE
The Air Valves feeding the hold-down & wringer rolls are positioned on the support structure directly east of the first dragout tank.
If the roll pressure is not released, the strip will crease as it is pulled through the line.
Is there a 1" gap between the Conductor/Carrier rolls and the Hold-down/Wringer rolls?
No
Yes
3

Attachment 5

Example of a Standard Operating Procedure

USING TRAINING MANUALS

JOB PROFILE REFERENCE:

72.092-G15	72.084	72.085	72.086	72.087	72.088
72.215	72.207-G14	72.090	72.091	72.081	72.098
72.110	72.262	72.252-G13	72.153	72.155	72.156
72.157	72.158	72.089-J12	72.208	72.210	72.211
72.213	72.214	72.216	72.217	72.112	72.253
72.255	72.259	72.266	72.269	72.273	72.277
72.278	72.111				

SCOPE:

This procedure outlines the method used to train operators in the correct method of performing an assigned job function. It also covers the method used to certify a trainee has shown their competency in performing a task.

PURPOSE:

The Cokemaking Training book is a record of each trainee's progress in job training. It is designed to provide the trainee with a map of the knowledge and skills required to perform a specific job function in a safe and competent manner. Trainees should use this book to record the job related tasks in which they have been trained and to identify those tasks in which they require training. The key to this process is the chart that accompanies each job, it is called a "Job Profile" chart and it outlines the duties and tasks associated with each job.

1. **WHAT IS A DACUM ?**

   A process called "DACUM" is used to define the job. The DACUM (Developing A CurriculUM) is a method of performing a job analysis. It provides a matrix that is a job description.

   The DACUM is produced by a panel of knowledge experts in the field of the job. For example, the Heater DACUM session was completed with Heaters, Foremen,

Production Engineers and Heater Assistants in attendance.

The Job Profile chart that results from this analysis is a detailed breakdown of the skills and competencies that are involved performing that job.

The analysis also provides the following information: an organization chart as it relates to the job function, a list of desirable behaviours, traits and attitudes, a listing of the tools and equipment required on the job, future trends as viewed by the panel, and the general skills and knowledge required to perform the job.

RESPONSIBILITY:

1. Trainee will record and track their training progress on the Job Profile chart. The trainee must constantly keep their trainers and supervision aware of their progress and their need for further training in the tasks where they lack experience or knowledge. They must also see that their Personal Employee Training is up to date. It is their personal record of training progress. The book is to be kept in a locked filing cabinet in the appropriate control room where the trainee is working. It is only to be accessed by the trainee or their supervisor. The training books are private records of your status and are to be viewed and altered only by the trainee or their trainers. The trainee must demonstrate to the trainer that they can competently perform the assigned task in order to have both the trainer and validator sign them off as trained. Only when the trainee has the trainer's and validator's signature will they be credited with being trained and competent in that task.

2. Trainer will provide complete training in the task assigned to the trainee based on the Job Profile chart. When the trainee has demonstrated competency in a task then the trainer will sign them off as trained.

3. Validator will observe the trainee performing an assigned task. When the trainee has demonstrated competency then the validator will sign them off as trained.

4. Training Skill Development will track the recording of training history and skills of trainees.

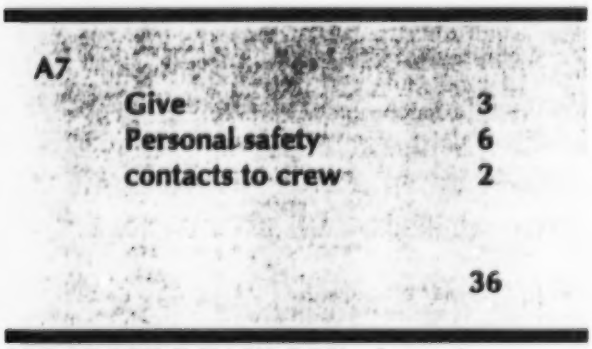
DETAILED OPERATING PROCEDURES:

1. USING THE JOB PROFILE CHART:

NOTE: All examples used are from the Heater Job Profile chart. Listed along the left hand column of the Job Profile chart are the duties associated with the job. A duty is an arbitrary major grouping of the jobs activites into categories of related tasks. Duties are assigned an alphabetical designation, for example, Duty "C" refers to "Monitoring All Emission Control Systems".

Arranged from left to right across the page are the various tasks associated with the performance of each duty. A task is a work activity that can be observed or measured and which consists of a number of steps which lead to a product, service or decision. Tasks are referred to by the Duty which they fall under and by a numerical designation, for example Task "F8" refers to "Adjusting Top Pressures".

Each task box also contains a series of numbers, these numbers reflect the Job Profile rating system and works in the following fashion:



JOB PROFILE TASK BOX - Legend

The four numbers listed vertically in the right of the box refer to the following training criteria:

Top Number - **Frequency** the Task is Performed (scale of 1 - 6)

Upper Middle Number - **Criticality** of the Task (scale of 1 - 6)

Lower Middle Number - **Difficulty** of the Task (scale of 1 - 6)

Bottom number - (in this.case 36) refers to the TPN (Task Priority Number). It is the product of multiplying the Frequency, Criticality and Difficulty numbers.

The rating system works as follows:

RATING	HOW FREQUENT	HOW CRITICAL	HOW DIFFICULT
1	Once a Year	Little or no Impact	None
2	Once a Month	Small Impact	Easy
3	Once or Twice a Week	Moderate Impact	Basic
4	Once a Day	Noticeable Impact	Moderately Difficult
5	Once a Shift	Serious Impact	Hard
6	More than Once a Shift	Catastrophic, Death or Destruction	Extremely Difficult

2. SOURCES OF TRAINING:

The training that you will receive will come in various forms and from many different individuals. The "mentor" system will couple you with an experienced operator who will show you the proper way to perform a particular task. Usually this person will be

also be a Production Engineer or Shift Foreman. Some training may take place in a formal classroom setting with a Production Engineer as your instructor.

One of the most important tools to your training is the Standard Operating Procedures Manual, found in each control room. A copy of this book exists for each job within the Cokemaking Business Unit. In each book you will find the standard operating procedures that correspond to the Job Profile chart for that job.

A standard operating procedure is a document that will be provided with a written description of how to perform a particular task. It is a step-by-step listing of how to perform a task along with associated safety information, background and ways to react to certain results. Each task may have more than one standard operating procedure accompanying it.

The combination of the "mentor" system, formal instruction and proper use of the Standard Operating Procedures Manual will provide the trainee with the necessary resources to become authorized as competent in all tasks required to perform a certain job.

3. CERTIFICATION OF TRAINEE COMPETENCY:

Once a trainee has received the proper training in a certain task, the necessary "mentor" training, classroom theory and reviewed the pertinent Standard Operating Procedures his knowledge and ability to perform a task will be evaluated by one of his immediate trainers (ie, in this case a Heater).

This competency will also be endorsed by a second person called a Validator (ie, another Heater or a Production Engineer). If deemed as competent in the task the trainer and validator will sign and date the Training Authorization Sheets and initial the appropriate box on the trainee's Job Profile chart. The trainee will now be regarded as having met the training requirements for that task.

It is expected that an employee may train on several tasks at a time due to the nature of the job (ie, one day he may be setting drafts, the next day learning the proper use of control charts). This system lets training occur while still permitting maintenance to be done in a timely manner.

4. **FINAL JOB AUTHORIZATION:**

Once signed off on all tasks as listed on the Job Profile chart, an employee has now demonstrated competency in all aspects of the job as defined in the DACUM process. He is now regarded as qualified or "certified operator" to perform this job function.

ASSOCIATED FILES:

None.

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